BACK SUPPORT SYSTEM

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The field of this invention relates to a back support system and more particularly to a back support system that is designed to be utilized as the back of a chair or in conjunction with the back of a chair.

DESCRIPTION OF THE RELATED ART

The subject matter of the present invention is going to be discussed in relation to a wheelchair. However, it is considered to be within the scope of this invention that the subject invention can be utilized in conjunction with any chair such as a seat in an aircraft, truck, automobile, ergonomic designed chair, work station chair, wheelchair or theater seat.

Users of wheelchairs are inherently prone to occupying a wheelchair for an extended length of time. For a human body to sit in one particular position over an extended length of time is not only uncomfortable but can cause injuries creating back pain. For reasons to prevent and alleviate any injuries or back pain,

the normal technique is to remove the individual from the wheelchair, reconfigure the individual and have the individual to remain free of the wheelchair for a period of time. This is not always a convenient procedure. It would be desirable to design a wheelchair that was constructed in a manner to provide the individual with an orthopedic back support over an extended period of time and also was constructed so as to encourage proper posture and allow an easily varied amount of lumbar support encouraging relief and prevention of back pain and provide positioning to control one's spine.

Previous seat design in the past has appeared to be totally inappropriate and unacceptable for the general public. It has been demonstrated that sitting reduced the normal lumbar curve and that prolonged sitting in this posture can produce low back pains and even disc degeneration. Chair design ought to be based on the anatomy of the seated human.

In the past, there have been attempts at designing a back support that includes some form of support reducing bulging disc pressure while sitting which is accomplished by the cushion of the back support being contoured to follow the natural lines of the human body. For the most part, these prior art devices have been static including some form of a cushioning arrangement and not including any form of adjustability so as to vary the amount of pressure that is being applied to the back of the individual so as to provide an increased level of support and comfort. It has been known to include an inflatable bladder in conjunction with

the back of a wheelchair. The design of these prior art bladders when inflated apply direct pressure to discs therefore acerbating back pain. However, the inflating and deflating of these prior art bladders is not easily accomplished and not readily accessible to the user. Therefore, the changing of the inflation and deflation of the bladder is definitely inconvenient, and as a result is accomplished infrequently. Also, these bladders have not been designed to ergonomically fit with the muscular system of the anatomy of a human back.

SUMMARY OF THE INVENTION

A back support system which comprises a rigid base which has an inflatable bladder assembly mounted on the front surface of the rigid base. The inflatable bladder assembly includes several sets of bladders with each set comprising at least two in number of inflatable bladders. Each of the inflatable bladders are spaced from the mid-axis of the base so no force from a bladder will be applied directly to the user's spine area. Inflation of the bladders is accomplished by means of an air compressor with supplying of the compressed air to each of the bladders to be accomplished by a manually controllable valve assembly located directly adjacent the user.

Another embodiment of back support system where all of the bladders within each set of bladders is activated

simultaneously.

A further embodiment of back support system of this invention where the operation of the inflation of the bladders is accomplished by the use of a battery.

A further embodiment of back support system of this invention where there is a set of upper lumbar bladders located in conjunction with the inflatable bladder assembly.

A still further embodiment of back support system of this invention where there is a middle lumbar set of bladders within the inflatable bladder assembly.

A still further embodiment of back support system of this invention where there is utilized a lower lumbar bladder as one of the sets of bladders.

A further embodiment of back support system of this invention where there is incorporated a tilt bladder in conjunction with the rigid base which forms the back of the chair.

A further embodiment of back support system of this invention where the pad includes inflatable bolsters located at the side edges of the rigid base which is to support the back area of the user.

A further embodiment of back support system of this invention where the base comprises a pair of rigid plates which are hingedly connected together at one edge and there being a tilt bladder located between these rigid plates so that one plate can be tilted relative to the other plate thereby providing a chair back that can be moved to different tiltable positions.

A still further embodiment of back support system of this invention utilizes a main section which is to be located across the back of the user. An inflatable bladder assembly is mounted in part on the front surface of the main section with the inflatable bladder assembly including several different sets of bladder. Hingedly connected to each side edge of the main section is a bolster with this connection forming a hinge axis for each bolster. Each hinge axis will permit movement of its respective bolster relative to the main section so as to permit increase and decrease of the lateral support being applied to the user. A series of valves are provided that are manually operable by the user to vary the inflation and deflation of the bladders.

A still further embodiment of back support system of this invention where there is a rear inflatable bladder mounted on the rear surface of the main section. The main section also includes a transverse axis that permits the main section to pivot. Inflation of the rear inflatable bladder causes the main section to pivot and thereby vary the amount of tilt to the back support.

A further embodiment of back support system of this invention utilizes a main section to be located across the back of the user and an inflatable bladder assembly mounted on the front of this main section. A rear inflatable bladder is mounted in conjunction with the rear surface of this main section with the main section also including a transverse axis permitting the main section to pivot. Inflation of the rear inflatable bladder causes the main section to pivot to assume various tilted or inclined

positions relative to the user. There is also included a series of controls that is manually operable by the user to vary the inflation and deflation of the inflatable bladders mounted on the main section and also the rear inflatable bladder.

One of the primary objectives of the present invention is to construct a chair back which includes a series of inflatable bladders with no inflatable bladder applying direct pressure to the spine of the user of the chair which assists in controlling alignment of the spine without putting pressure on the spine. Pressure on the spine could cause pain and/or a degenerative disc.

Another objective of the present invention is to construct a chair back which utilizes a specific series of inflatable bladders that are ergonomically shaped to apply pressure to the different muscle groups that are located within the back of the user.

Another objective of the present invention is to construct a chair back where the inflatable bladders incorporated therein can be selectively activated and deactivated according to individual comfort.

Another objective of the present invention is to construct a chair back which will permit a user of the chair to occupy the chair for an extended length of time in a comfortable manner.

Another objective of the present invention is to construct a chair back which reduces risk of spinal deformity.

Another objective of the present invention is to

construct a back support system that can be easily installed on virtually all models of wheelchairs and can be constructed to accommodate to most all conventional chairs.

Another objective of the present invention is to construct a back support system for a chair back that provides for a significantly enhanced amount of comfort to the user.

Another objective of the chair back of the present invention is to provide a back support system that fits to a variety of different individuals.

Another objective of the chair back of the present invention is to provide a back support system that assists the musculature of the user and to align the spine.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, reference is to be made to the accompanying drawings. It is to be understood that the present invention is not limited to the precise arrangement shown in the drawings.

Figure 1 shows a schematic view of the back support system of the present invention;

Figure 2 is an internal view of the back support system of the present invention showing the arrangement of the frontal inflatable bladder assembly that is utilized in conjunction with the back support system of the present invention;

Figure 3 is a transverse cross-sectional view through the back support system of the present invention taken along line 3-3 of Figure 1 showing the bolsters in conjunction with the back support system being located in the fully retracted position;

Figure 4 is a cross-sectional view similar to Figure 3 showing the bolsters in a fully extended position;

Figure 5 is a cross-sectional view similar to Figure 3 showing the back support system with mounts for connecting to a wheelchair and a housing for enclosing the air compressor and battery source of power;

Figure 6 is a longitudinal cross-sectional view through the back support system of the present invention taken along line 6-6 of Figure 1 showing the back support system in a minimal tilt position; and

Figure 7 is a cross-sectional view similar to Figure 6 but showing the back support system in the maximum tilted position.

DETAILED DESCRIPTION OF THE INVENTION

Referring particularly to the drawings, there is shown the back support system 10 of this invention. Back support system 10 includes a control housing 12. Inside the control housing 12 there is located an electrically operated air compressor 14. Operation of the air compressor 14 is accomplished by means of a series of batteries 16. The air compressor 14 supplies compressed air through supply conduit 18. Electrical power also is supplied by the batteries 16 to electrical conduit 20. Electrical conduit 20 and supply conduit 18 connect with a valve housing 22. Contained within the valve housing 22 are a series of valves (not shown) that are capable of supplying pressurized air from the supply conduit 18 to within outlet conduits 24, 26, 28, 30, 32 and 34. Manual pressing of switch 36, which is mounted on housing 22, is to control the pressurized air that is being supplied into the outlet conduit 24. Also mounted on the housing 22 are switches 38, 40, 42, 44, and 46 which similarly supply pressurized air into their respective conduits 26, 28, 30, 32 and 34. Switches 36, 38, 40, 42, 44 and 46 can each be pressed and released to a hold position which will retain the quantity of pressurized air that

has been supplied within their respective bladders. Each of the switches 36-46 are also capable of being pressed to a vent position. In that position, the pressurized air contained within its respective outlet conduit 24-34 is vented to the ambient. Switches 36-46 each connect with the electrically operated valves (not shown) which are mounted within valve housing 22 and are supplied electrical power by conduit 20.

Outlet conduit 34 connects with rear inflatable bladder 48. Outlet conduit 32 connects with right bolster bladder 50. Outlet conduit 30 connects with left bolster bladder 52. Outlet conduit 28 connects with upper lumbar bladders 54, 56, 58 and 60. Outlet conduit 24 connects with middle lumbar bladders 62, 64, 66 and 68. Outlet conduit 26 connects with lower lumbar bladders 70 and 72.

The upper lumbar bladders 54 and 60 are each shaped specifically to apply pressure to the deltoid muscle, the infraspinatus muscle, and the terres minor and major muscles. It is to be understood that these muscles in the area of the back overlap. The upper lumbar bladders 56 and 58 are also shaped to apply pressure to the upper portion of the trapezius muscle and also to the serratus posterior superior muscle. The middle lumbar bladders 62 and 68 are shaped to apply pressure to the lower portion of the trapezius muscle, the quadratus lumborum, erector spinae muscle, external obdominal oblique muscle and the internal abdominal oblique muscle. It is to be understood that each of the muscles that are being discussed are on both sides of the spine

with it being understood that the spine is in alignment with the mid axis 98. The middle lumbar bladders 64 and 66 are shaped specifically to apply pressure primarily to the spine of scapula muscle, rhomboideus major muscle and the serratus posterior superior muscle. The lower lumbar bladders 70 and 72 are each specifically shaped to apply pressure primarily to the thoracolumbar facia, spinalis thoracis, erector spinae muscle, longissimus thoracis, iliocostalis lumborum, latissimus dorsi, trapezius and serrated posterior inferior oblique muscle.

The height of the back support system 10 of this invention is selected so that the lumbar vertebrae of the user's spine will generally be located between the lower portions of the lower lumbar bladders 70 and 72. The remaining portion of the back support system 10 is located primarily in the area of the thoracic vertebrae of the spine. The back support system of this invention is not designed to have any contact with the cervical lumbar region of the spine.

Rear inflatable bladder 48 is mounted within a base which comprises fixed plate 74 and movable plate 76 with bladder 48 mounted between plates 74 and 76. The movable plate 76 is mounted by a hinge 78 to the lower edge 80 of the fixed plate 74. At the upper edge 82 of the fixed plate 74 there is mounted a flexible dust cover 84. The axis of hinge 78 is perpendicular to the mid-axis 98. The fixed plate 74 is mounted against a chair back 73, shown in Figure 3.

When the rear inflatable bladder 48 is not activated,

the plates 74 and 76 are in the position shown in Figure 6 of the drawing. However, when switch 46 is pressed, pressurized air is supplied into the bladder 48 and the bladder 48 can be extended to the maximum position depicted by arrow 86 which will normally be about ten degrees. The dust cover 84 prevents foreign material from entering to within the wedged shape cavity 88 that is produced between the fixed plate 74 and the movable plate 76.

The fixed plate 74 is to be mounted either on a chair back or as a chair back. For example, in the environment of a wheelchair, the fixed plate 74 can be mounted by mounting brackets 90 and 92 to the frame structure of the wheelchair, which is not shown. These mounting brackets 90 and 92 are shown in Figure 5. Activating and causing pressurized air to enter the bladder 48 will change the position of the movable plate 76 from an inclined position, as shown in Figure 6, to an upright position, shown in Figure 7. It is to be understood that the amount of inclination or the amount of uprightness is to be manually selected according to the individual's desires. Figure 5 also shows the control housing mounted on the rear surface of the fixed plate 74.

When the user presses switch 44, pressurized air is supplied to the right bolster bladder 50 which is wedged between the movable plate 76 and right bolster plate 94. The right bolster plate 94 is hingedly connected to the movable plate 76 by means of a hinge 96. Hinge 96 is located substantially parallel to the mid-axis 98. Mid-axis 98 is located at the transverse center of the movable plate 76 and extends longitudinally. Dust

cover 100 connects between the movable plate 76 and the right bolster plate 94 to prevent foreign material from entering the wedge shaped cavity 102 formed between the movable plate 76 and the right bolster plate 94. When the user presses switch 44, inflation of the bladder 50 will occur which will cause the right bolster plate 94 to move from the retracted position, shown in Figure 3, to the expanded position, shown in Figure 4. The expanded position will apply pressure to the right side of the user when sitting in a chair to provide lateral support to the user of the chair.

When the user presses switch 42, pressurized air is to be supplied to the left bolster bladder 62 which is wedged between the movable plate 76 and a left bolster plate 104. The left bolster plate 104 is hingedly connected by a hinge 106 to the movable plate 76. The axis of the hinge 106 is substantially parallel to the mid-axis 98. A dust cover 108 extends between the movable plate 76 and the left bolster plate 104 to prevent foreign material from entering the wedged shape cavity 110 which is located between the movable plate 76 and the left bolster plate 110. When the user causes pressurized air to enter into the left bolster bladder 52, pressure will be applied to the left side of the user to provide lateral support to the user of the chair.

Mounted on the frontal surface of the right bolster plate 94 are bladders 62 and 54. Mounted on the frontal surface of the left bolster plate 104 are bladders 60 and 68. Bladders 54 and 62 are covered by a fabric or plastic cover 112. The bladders

60 and 68 are covered by a cover 114, which is also formed of plastic or fabric. It is to be understood that each of the inflatable bladders included within this invention are to be formed as a sheet material enclosure with the wall of such constructed of either a rubberized fabric or plastic material. Each bladder can be replaced for repair. The maximum pressure supplied to each bladder will generally not exceed two pounds per square inch. The bladder covers are removable for washing purposes and then are replaceable.

Bladders 56 and 58 are fixedly mounted onto the movable plate 76 with bladder 56 being located to one side and spaced from the mid-axis 98 and bladder 58 located to the opposite side and spaced from the mid-axis 98. Similarly, the bladders 64 and 66 are fixedly mounted onto the movable plate 76 with bladder 64 located on one side of the mid-axis 98 and bladder 66 located on the opposite side of the mid-axis 98 and spaced therefrom. Similarly, the bladders 70 and 72 are fixedly mounted onto the movable plate 76 with bladder 70 being located on one side of the mid-axis 98 and bladder 72 located on the opposite side of the mid-axis 98 with both the bladders 70 and 72 being spaced from this mid-axis 98. The mid-axis 98 is to basically align with the spine of the user. This will result in that there is no pressure being applied by a bladder directly to the spine. The applying of pressure to the spine at times, for certain individuals, can become uncomfortable. The upper lumbar bladders 54, 56, 58 and 60 are designed to apply pressure to the muscle group of the upper

lumbar region of a person's back. The middle lumbar bladders 62, 64, 66 and 68 are designed to apply pressure to the middle lumbar muscle group of the person's back. Bladders 70 and 72 are designed to apply pressure to the lower lumbar muscle group region of the person's back. In essence, the arrangement of the bladders mirrors the musculature structure of the user's back. Bladders 56, 64 and 70 are covered by a cover 116. Bladders 58, 66 and 72 are covered by a cover 118. Bladders typically will be constructed of polyester/polyurethane or polyurethane/vinyl material and not flammable. The covers 112, 114, 116 and 118 are also constructed of a fabric which is not flammable.

For a description of the constructing of each of the bladders, reference is to be to bladder 70 shown in detail in Figures 8, 9 and 10. Bladder 70 has an internal chamber 71 located internally of fabric cover 116. Located within chamber 71 is an open cell foam pad 73. Pad 73 will normally be constructed of polyurethane. Air is supplied internally of sheet 75 within internal chamber 79 through outlet conduit 76 through port 77.

The foam that is used within each of the bladders is to have an indention load displacement of between twelve to twenty-six. Generally, this indention load displacement is within the low range. Basically, the trait of the foam, such as foam pad 73, is to be such that when it is compressed and the force is released from the foam that it will quickly spring back to its original shape.

With ambient air pressure in bladder 70, the position of

bladder 70 will be as shown in Figure 8 where sheet 75 closely conforms to foam pad 73 and cover 116 abuts sheet 75. Adding of pressurized air to within internal chamber 79 causes expansion of sheet 75 and fabric cover 116 as shown in Figure 9. When a person's body 81 leans against cover 116 and applies pressure, the inflated appearance of bladder 70 is substantially eliminated with sheet 75 being pressed against pad 73 assuming the position shown representatively in Figure 10.

Pressing of switch 40 will cause pressurized air to be supplied simultaneously to bladders 54, 56, 58 and 60. Pressing of switch 38 will cause pressurized air to be supplied simultaneously to bladders 70 and 72. Pressing of switch 36 will cause pressurized air to be supplied simultaneously to bladders 62, 64, 66 and 68.

Each of the bladders that have been previously discussed can be vented through their supply conduits 24, 26, 28, 30, 32 and 34 by merely pressing of the switches 36, 38, 40, 42, 44 and 46 in an opposite direction where this venting occurs through the valve, which is not shown, that is associated with each of the switches 36-46. This venting causes their respective inflatable bladders to deflate or move to a lower amount of inflation, again according to the individual's desires. At times, the user can change the inflation of bladders to alter the pressure that is being applied. This changing of the pressure is in order to increase comfort and minimize the possibility of creating of any sore in conjunction with a user's back. The use of bladders provides localized

pressure but distributes the pressure.

Connecting with the conduit 24 is a connecting conduit 120. The connecting conduit 120 connects at one end with the bladders 62 and 64 and at the opposite end with the bladders 66 and 68.

The supply conduit 28 connects to a connecting conduit 122 with one end of the connecting conduit 122 connecting with the bladders 54 and 56 and the other end of the connecting conduit 122 connecting with the bladders 58 and 60. Similarly, there is a connecting conduit 124 that connects with a supply conduit 26 with one end of the connecting conduit 124 connecting with bladder 70 and the opposite end of the connecting conduit 124 connecting with bladder 72.

In summary, the user, when utilizing the back support system 10 of this invention, has the capability of changing the overall tilt of the back support system 10 and also has the option of increasing or decreasing lateral support by moving of the right bolster plate 94 or the left bolster plate 104. Additionally, the user has the capability of applying increased pressure to the lower lumbar region through bladders 70 and 72, through the middle lumbar region through bladders 62, 64, 66 and 68 or the upper lumbar region through bladders 54, 56, 58 and 60. The back support system is designed to be constructed in any convenient size with typical sizes being twelve inches, fourteen inches, sixteen inches, eighteen inches, twenty inches, twenty-two inches, twenty-four inches, twenty-sic inches, twenty-eight inches and

thirty inches.

By the design of this unique medical device, structural support of the back is maintained. Prolonged seating can cause musculo-skeletal problems. This design allows postures to adjust and reduce the lowest disc compression which ultimately causes discomfort and pain. During sitting, activity of the back muscles is similar to that during standing, but in supported sitting, as with elbows resting on the knees there is no activity in the lumbar back muscles, and with arms resting on an armrest, back muscle activity is decreased. In reclined sitting, the backrest supports the weight of the thorax, lessening the need for muscular support. Increasing the declination of the backrest of a seat decreases lumbar back muscle activity. As the spine bends forward, there is an increase in the activity of the back muscles. Gravity, but the extent produces the movement of forward flexion and the rate at which it proceeds, is controlled by the eccentric contraction of the back muscles and tension in its posterior ligaments. If forward flexion increases, transition of spinal-load bearing from muscles to the ligaments system takes place. The downward direction of their action as the back muscles contract exert a longitudinal compression of lumbar vertebral column, and this compression raises the pressure in the lumbar intervertebral discs. Disc pressures and myoelectric activity of the back muscles quantifies the stresses applied to the lumbar spine in various postures. The erector spinae muscle group plays a critical role in the dynamic stability of the lumbar spine. As

the spine bends forward, there is an increase in the activity of the back therefore is associated with the rise in nuclear pressure. When measured at intervertebral discs, the nuclear pressure correlates with the degree of myoelectric activity in the back muscles. As muscle activity increases, disc pressure rises. At a certain point during forward flexion, the activity in the back muscles ceases and tension in its posterior ligaments increases. This phenomenon takes place only when the spine has reached about ninety percent maximum flexion. To control this activity the back support system 10 will adapt to the following, postures leaning back using a reclined backrest give the lowest lumbar-sacral disc loading regardless of the inclination the direct location of the seat and by postures in which an individual is bending forward with the spine kyphotic give the highest disc loading regardless where the individual has been seated or positioned. It is advantageous to tilt the back forward or backward by five degrees rather than to have a horizontal seat pan in forward bending postures. If an erect trunk posture is attained or a reclined backrest is in use disc compression will be altered when the recline function moves forward or backwards by five degrees. There is a correlation between discomfort and disc compression.

The back support system 10 allows the user to move in multiple planes rather than a fixed manner. Another advantage enables the occupant to have multiple back positions by inclining and reclining and increasing pressure along major muscle groups to

facilitate postural changes. The back support system 10 is a multi-positioning device that reduces back and lower back pain by increasing the over muscular activity of the back.

The present invention may be embodied in other specific forms without departing from the essential attributes thereof. Reference should be made to the appending claims rather than the foregoing specification as indicating the scope of the invention.